Inorganic Matrix for High Performance Composites and Sandwich Plates

J. Giancaspro, C.G. Papakonstantinou, and P.N. Balaguru

Rutgers, the State University of New Jersey

Department of Civil Engineering

Piscataway, New Jersey 08854

R.E. Lyon

Program Manager

FAA Technical Center

Atlantic City Int'l Airport

New Jersey

Abstract

This paper presents the use of inorganic (Geopolymer) matrix for high strength composites and sandwich plates. The performance of this composite is also compared with other high temperature resistant composites. Current research focuses on the use of high strength carbon fibers combined with low cost glass fibers to obtain a hybrid composite that is both economical and strong. The Eglass fabrics were used as a core with carbon fibers on the tension face and both on the tension and compression faces. Another aspect of hybrid composite research deals with combining a fireproof inorganic matrix and an organic matrix that provides ductility and better strength. Stitched glass fabric was coated with inorganic matrix on one side and organic matrix on the other side. Two fabrics were sandwiched to make a plate with an organic-fiber core and inorganic skins on both sides. The results indicate that the process is viable in terms of fabrication

and bond between the inorganic and organic systems. Composites made using carbon, glass, and combinations of carbon and glass fibers were evaluated in bending and tension. Processing requirements and mechanical properties of carbon/carbon composites, ceramic matrix composites made with silicon carbide, silicon nitride and alumina fibers, and carbon/polysialate composites were compiled to study the relative performance of Geopolymer composites. The results indicate that carbon/polysialate composites have mechanical properties that are better than most of the fire-resistant composites. Structural sandwich plates are a special form of laminated composite in which thin, strong, stiff, hard, but relatively heavy facings are combined with thick, relatively soft, light, and weaker cores to provide a lightweight composite that is stronger and stiffer in most respects than the sum of the individual stiffness and strengths. In this investigation, lightweight cores with densities of about 700 kg/m^3 were made using ceramic spheres and the inorganic matrix. These cores have a compressive strength of about 5 MPa. Thin slabs of these cores were externally reinforced with carbon fabric to obtain hybrid composite slabs and were tested under three-point bending. The primary test variables were the amount of carbon reinforcement and the behavior after exposure to temperatures of 200, 400, 600, and 800?C. Both experimental results and analysis of slabs are presented.